

Claim 1 (currently amended). A process for enriching LNG in methane, comprising the steps:

- a) feeding an initial LNG stream to flow in a first path in a heat exchanger wherein the LNG stream partially vaporizes,
- b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,
- c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,
- d) warming the methane enriched gas stream while flowing in a second path in the heat exchanger,
- e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,
- f) further cooling the compressed and cooled methane enriched gas stream to liquid state while flowing in a third path in the heat exchanger,
- g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top

of the distillation column as a reflux, and the other of which is expanded and provided as a methane product.

Claim 2 (original). The process of claim 1 wherein step a) includes pumping the initial LNG from a storage region to said heat exchanger.

Claim 3 (original). The process of claim 1 wherein said ethane enriched liquid stream is removed from an intermediate tray in the distillation column, and wherein a propane-butane enriched bottom liquid is produced in the distillation column, as a propane-butane product.

Claim 4 (currently amended). A process for enriching LNG in methane, comprising the steps:

- a) feeding an initial LNG stream to a heat exchanger wherein the LNG stream partially vaporizes,
- b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,
- c) operating the distillation column to separate the partially vaporized initial LNG stream

into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,

d) warming the methane enriched gas stream,
e) compressing the warmed methane enriched
gas stream, and cooling the compressed methane enriched
gas stream to a temperature at or near ambient,

f) further cooling the compressed and
cooled methane enriched gas stream to liquid state,

g) and distributing the compressed and
liquefied methane enriched gas stream into two streams,
one of which is expanded and then introduced to the top
of the distillation column as a reflux, and the other
of which is expanded and provided as a methane product,

h) The method of claim 1 and wherein the
fluid pressure in the distillation column is between 15
and 72 psia; and wherein a compressor is employed to
compress the methane enriched gas stream in step e),
the compressor having a discharge pressure between 58
and 174 psia.

Claim 5 (currently amended). The method process of
claim 1 wherein the fluid pressure in the distillation
column is between 72-174 psia; an upper [[a]]
compressor is employed to compress the methane enriched

gas stream in step e), the compressor having a discharge pressure between 174 and 363 psia.

Claim 6 (currently amended). A process for enriching LNG in methane, comprising the steps:

- a) feeding an initial LNG stream to a heat exchanger wherein the LNG stream partially vaporizes,
- b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,
- c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,
- d) warming the methane enriched gas stream,
- e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,
- f) further cooling the compressed and cooled methane enriched gas stream to liquid state,
- g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top

of the distillation column as a reflux, and the other
of which is expanded and provided as a methane product,

h) The method of claim 1 and wherein the
step g) expansions are throttling processes, which are
controlled to thereby control the relative flow
distributions of said two streams.

Claim 7 (currently amended) A process for enriching
LNG in methane, comprising the steps:

a) feeding an initial LNG stream to a heat
exchanger wherein the LNG stream partially vaporizes,

b) feeding the partially vaporized initial
LNG stream into a middle region of a distillation
column that has a concentration section and a stripping
section,

c) operating the distillation column to
separate the partially vaporized initial LNG stream
into a methane enriched overhead gas stream and into an
ethane enriched liquid product stream,

d) warming the methane enriched gas stream,

e) compressing the warmed methane enriched
gas stream, and cooling the compressed methane enriched
gas stream to a temperature at or near ambient,

f) further cooling the compressed and
cooled methane enriched gas stream to liquid state,

g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top of the distillation column as a reflux, and the other of which is expanded and provided as a methane product,

h) The process of claim 1 and wherein the composition of the initial LNG is about 0.3% of nitrogen, about 85.8% of methane, about 9.6% of ethane, about 3% of propane, about 1% of i-butane, about 0.3% of total i-pentane and n-hexane; the composition of the methane product is about 0.34% of nitrogen, about 98% of methane, about 1.7% of ethane; and the composition of the ethane product is about 65.5% of ethane, about 24.1% of propane, about 8% of i-butane, about 2.4% of total i-pentane and n-hexane[.], wherein said stated percentages are mol percentages.

Claim 8 (currently amended). The process method of claim 7 wherein the fluid pressure in the distillation column is 6 bara (87 psia), the compressor discharge pressure is 15 bara (217 psia); the vapor mole fraction of the partially vaporized initial LNG at introduction to the distillation column is 0.84%; the number of theoretical trays in the distillation column is 12,

including 4 trays in the tower upper section, and 8 trays in the tower lower section.

Claim 9 (currently amended). A process for enriching LNG in methane, comprising the steps:

- a) feeding an initial LNG stream to a heat exchanger wherein the LNG stream partially vaporizes,
- b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,
- c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,
- d) warming the methane enriched gas stream,
- e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,
- f) further cooling the compressed and cooled methane enriched gas stream to liquid state,
- g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top

of the distillation column as a reflux, and the other
of which is expanded and provided as a methane product,

h) said ethane enriched stream being removed
from an intermediate tray in the distillation column,
and wherein a propane-butane enriched bottom liquid is
produced in the distillation column, as a propane-
butane product, and

i) The process of claim 3 and wherein the
composition of the ethane product is about 1.3% of
methane, about 75.8% of ethane, about 21.9% of propane,
about 1% of i-butane; the composition of the propane-
butane product is about 0.2% of ethane, about 34.5% or
propane, about 49% of i-butane, about 16.3% of total
i-pentane and n-hexane; the number of theoretical trays
in the distillation column is 12, including 4 trays in
the tower upper section, 3 trays in the tower middle
section, and 5 trays in the tower lower section[.].
wherein said stated percentages are mol percentages.

Claim 10 (currently amended). A process for enriching
LNG in methane, comprising the steps:

a) feeding an initial LNG stream to a heat
exchanger wherein the LNG stream partially vaporizes,
b) feeding the partially vaporized initial
LNG stream into a middle region of a distillation

column that has a concentration section and a stripping section,

c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,

d) warming the methane enriched gas stream,

e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,

f) further cooling the compressed and cooled methane enriched gas stream to liquid state,

g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top of the distillation column as a reflux, and the other of which is expanded and provided as a methane product,

h) The process of claim 1 and wherein fluid pressure in the distillation column is about 1.2 bara (17 psia), the compressor compression discharge pressure is about 6 bara (87 psia); the vapor mole fraction of the partially vaporized initial LNG at introduction to the distillation column is about 0.88; and the number of theoretical trays in the distillation column is 12,

including 4 trays in a tower upper section, and 8 trays in tower lower section.

Claim 11 (currently amended) A process for enriching LNG in methane, comprising the steps:

- a) feeding an initial LNG stream to a heat exchanger wherein the LNG stream partially vaporizes,
- b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,
- c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,
- d) warming the methane enriched gas stream,
- e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,
- f) further cooling the compressed and cooled methane enriched gas stream to liquid state,
- g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top

of the distillation column as a reflux, and the other of which is expanded and provided as a methane product,

h) The process of claim 1 and wherein due to increase in the temperature difference at the warm end of the heat exchanger the methane compressor compression discharge pressure of a provided and operated methane compressor decreases.

Claim 12 (currently amended). A process for enriching LNG in methane, comprising the steps:

a) feeding an initial LNG stream to flow in a first path in a heat exchanger wherein the LNG stream partially vaporizes,

b) feeding the partially vaporized initial LNG stream into a middle region of a distillation column that has a concentration section and a stripping section,

c) operating the distillation column to separate the partially vaporized initial LNG stream into a methane enriched overhead gas stream and into an ethane enriched liquid product stream,

d) warming the methane enriched gas stream while flowing in a second path in the heat exchanger,

e) compressing the warmed methane enriched gas stream, and cooling the compressed methane enriched gas stream to a temperature at or near ambient,

f) further cooling the compressed and cooled methane enriched gas stream to liquid state while flowing in a third path in the heat exchanger,

g) and distributing the compressed and liquefied methane enriched gas stream into two streams, one of which is expanded and then introduced to the top of the distillation column as a reflux, and the other of which is expanded and provided as a methane product,

h) The process of claim 1 and wherein said other stream is derived from said one enriched liquefied gas stream by separation in the column, and prior to said expansion of said other stream.

Claim 13 (original). The process of claim 1 wherein said other stream is derived from said one stream, within the distillation column.

Claim 14 (withdrawn). An apparatus for LNG enriching in methane by use of the methane cycle comprising:

a) a distillation column for separating a partially vaporized initial LNG stream into a methane enriched overhead gas stream and an ethane enriched

bottom liquid stream (ethane product), or into a methane enriched overhead gas stream, an ethane enriched intermediate liquid stream (ethane product) and a propane-butane enriched bottom liquid stream (propane-butane product),

b) a reboiler for vaporizing the liquid that flows down in the distillation column;

c) a compressor for increasing the pressure of the methane enriched gas stream;

d) a heat exchanger for cooling and liquefying the compressed methane enriched stream through heating the removed from the distillation column methane enriched overhead gas stream and vaporizing the initial LNG stream;

e) a storage for the initial LNG;

f) a pump for increasing the pressure of the initial LNG;

g) a storage for the methane product;

h) a storage for the at least one of the following: x₁) ethane product, and x₂) storages for the ethane product and propane-butane product.

Claim 15 (withdrawn). The apparatus of claim 14 including

- i) a first expansion valve for expanding methane enriched liquid stream for introduction to the top of the distillation column,
- ii) a second expansion valve for expanding another portion of improved methane enriched liquid stream, for use as a methane product.

Claim 16 (withdrawn). The apparatus of claim 14 including control means to control said first and second valves to thereby control the distribution of said portions of the methane enriched stream.